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stead of the wind theory of ocean currents various others have recently been suggested (Nansen, temperature; Pettersson, ice-melting) which are all more or less based on density compensation. Krümmel evaluates this factor correctly in according it only a secondary position as a current-producing agency. Currents due to density compensation are represented, on the one hand, by the cold bottom water which, with its polar beginnings, constitutes one section of a great but slow vertical current system and, on the other hand, in straits which connect basins of different density. Such are the Strait of Gibraltar and the sounds between the North and Baltic Seas; in the former case, the subordinate sea (Mediterranean) has the denser water, in the latter case it (Baltic) has the less dense. While in these theoretical discussions reference is rarely made to the actual conditions of the ocean, the survey of the ocean currents in the last section is constantly correlated with the preceding theoretical expositions, so that here the attempt is first made to bring theory and observation into coincidence or to explain the natural phenomena by means of the theory.

The section on currents alone occupies one-quarter of the whole work and possibly represents the most important advance in oceanographic science. It also best reveals Krümmel's masterly gift to hew a path through a chaos of new material and from the rough stones not only to erect a homogeneous edifice but also to keep a lookout from every one of its vantage-points, to open up new vistas and to discover gaps.

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## AN INTERPRETATION OF THE DISTRIBUTION OF THE REPTILES IN MAGGIE BASIN, NEVADA

By ALEXANDER G. RUTHVEN

In a recent paper<sup>1</sup> on the reptiles and amphibians of Maggie Basin, in northeastern Nevada, it was shown that the distribution of the species of these groups apparently corresponds closely with the distribution of certain environmental conditions chief of which are the presence of water, the nature of the soil and the presence of rocks. Since the distribution of the species is thus associated with physiographic features, it may be expected to exhibit characteristics due to changes in the geographical cycle and thus to be open to a more complete interpretation from this point of view. It is the purpose of this paper to discuss the effect of the geographical changes upon the habi-

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<sup>1</sup>The Reptiles and Amphibians collected in Northeastern Nevada by the Walker Newcomb Expedition of the University of Michigan. By Alexander G. Ruthven and Helen Thompson Gaige. *Univ. of Mich. Museum of Zool. Occ. Papers No. 8.*

tats, to show that the distribution of certain species may be explained by the geographical history of the region, and to consider the probable succession of habitats and fate of the associated species. Only the reptiles will be considered.

*Description of the Region.* Maggie Basin is a small intermontane basin in the Great Basin region. It is situated in northeastern Nevada, between the Cortez, Seetoya, Pinyon and River Ranges, in Elko and Eureka Counties. The lowest part of the basin has an altitude of 4,930 feet at Carlin and the surrounding mountains rise rather gradually from it, except the Cortez Range which has a steep eastward slope and reaches an elevation of 7,754 feet.

The climate is arid. The mean annual precipitation is about 7.22 inches, and as little as 2 inches may occur in one year. Much of the precipitation is in the form of snow and over 80 per cent. occurs between the months of November and May inclusive. During the summer months high temperatures (100°-106° F.) are frequent, and there are large diurnal variations in temperature (as great as 60°-64° F.). Killing frosts occur in all months.

The predominating vegetation is the open sage-brush association which occurs everywhere except on alkali spots, the immediate margin of permanent mountain streams and in the wide valley of the Humboldt River and the lower parts of tributary valleys. Along the permanent mountain and basin streams there are small groves of trees and shrubs, and in the valley of the Humboldt and the lower part of the tributary valleys the sage-brush is superseded by a zone of *Chrysothamnus pinifolius* Greene, and this in turn by a zone of grasses, principally *Elymus condensatus*.

The basin has drainage discharge to a lower level through the Humboldt River, which crosses the southern end. It is strongly aggraded, and the waste is piled high on the surrounding mountains. The general level of the basin floor deposits slopes to the wide valley of the Humboldt River and the valley of Maggie Creek in the middle of the basin, but they are deeply trenched, the valleys being continuous with the deeply cut mountain valleys.

With the exception of a few small mountain streams which flow directly into the Humboldt where it approaches the mountains, the streams are grouped into three minor systems known as Annie, Maggie and Susan Creeks. Maggie Creek is perennial; the other streams are intermittent. Many of the headwater branches in the mountains are also intermittent, while others exist ordinarily as disconnected and often discontinuous streams. It is only during the spring months and cloudbursts that these headwater branches unite and reach the main streams and the Humboldt River. Both the Humboldt River and Maggie Creek are meandering streams which flow through flat valleys and in the dry season do relatively little work.

The soil is principally a stony loam, which is coarser toward and on the mountains and becomes finer toward the middle of the basin. In the valleys of the Maggie and Humboldt and the mouths of the branch valleys the soil is a fine silt-like loam which is easily blown about by the wind, except close to the streams, where it is held by the greater growth of vegetation. The rock outcrops are, with one exception, confined to the mountains. The exception is a small hill near the middle of the basin. In the mountains they occur at all altitudes and, except in the canyons where Maggie Creek and the Humboldt River flow through the mountains, are relatively small and mostly broken up into large blocks. In Moleen Canyon and where the Humboldt flows across the

end of the Cortez Range there are rock cliffs, but these have been buried nearly to the summits with talus.

The general geographical conditions are apparently easily interpreted. The basin has been strongly aggraded and the deposits subsequently dissected. The dissection is still going forward, but the meandering nature of the permanent streams which carry the waste to lower levels, the small amount of precipitation, and the binding effect of the vegetation on the soil combine to keep transportation less effective than weathering. Thus, while the general tendency of the dissection is to expose the rocks of the buried mountains—and they have been uncovered where dissection has been most rapid, *viz.*, in the canyons where the trunk streams enter and leave the basin and on the small hill in the center of the basin—the outcrops are, in general, being broken up rather than exposed.

*Habitats.* The diversity of the topography gives a variety of environmental conditions to which the reptilian fauna responds. The relation between the environment and the fauna, as determined by field work extending over eight weeks in the summer of 1912, is shown in the following table.

LOCAL DISTRIBUTION OF THE REPTILES IN MAGGIE BASIN, NEVADA

| ECOLOGICAL DISTRIBUTION                                                               | GEOGRAPHIC DISTRIBUTION                                      |                                                                                       |                                                         | ABUNDANCE                                                                                    |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------|
|                                                                                       | On basin floor only                                          | Basin floor and mountains, all altitudes                                              | In mountains only                                       |                                                                                              |
| Terricolous species, occurring in all land habitats                                   |                                                              | <i>Pityophis c. sayi</i><br><i>Bascanion c. vestutum</i><br><i>Bascanion tæniatum</i> |                                                         | Apparently common throughout                                                                 |
| Terricolous species, apparently preferring vicinity of rocks but not confined to them |                                                              | <i>Crotalus lucifer</i>                                                               |                                                         | Common in mountains, rare on basin floor                                                     |
| Terricolous species, found only on fine soil                                          | <i>Phrynosoma hernandesi</i>                                 |                                                                                       |                                                         | In two places, not uncommon                                                                  |
|                                                                                       | <i>Crotaphytus wislizenii</i><br><i>Cnemidophorus tigris</i> | <i>Sceloporus graciosus</i>                                                           |                                                         | In one place, not common<br>In one place, common<br>Common on basin floor, rare in mountains |
| Saxicolous species, occurring on rock cliffs or on or in immediate vicinity of rocks  |                                                              | <i>Sceloporus biserialis</i>                                                          |                                                         | Common in mountains, rare on basin floor                                                     |
|                                                                                       |                                                              |                                                                                       | <i>Crotaphytus c. bail. yi</i>                          | Rather common in one place near base of mountains                                            |
|                                                                                       |                                                              |                                                                                       | <i>Uta s. nevadensis</i><br><i>Eumeces skiltonianus</i> | In two places near base of mountains, common<br>In one place (7,500 ft.), rather common      |
| Limnicolous species, occurring in immediate vicinity of permanent streams             | <i>Thamnophis o. elegans</i>                                 |                                                                                       |                                                         | Common                                                                                       |

There are basin floor forms, montane forms, and forms which have a more or less general occurrence, but there is no zonal distribution with altitude. The species which occur principally or only in the mountains are those which live on or among rocks. *Sceloporus biseriatus* and *Uta stansburiana nevadensis* are scansorial forms which are practically confined to rocky places; the *Sceloporus* is only rarely observed on the ground. *Crotaphytus collaris baileyi*, while not strictly scansorial in that it does not live on vertical cliffs and is often found on the ground, occurs only in the immediate vicinity of rocks about which it climbs and among which it seeks concealment. *Eumeces skiltonianus* is a secretive ground form which finds concealment among rocks. Although not strictly a saxicolous form, *Crotalus lucifer*, a ground species which is principally nocturnal and lives among the rocks or on open ground, seems to be chiefly confined to rock habitats, where it finds concealment during the day.

The montane species are not confined to any altitude and the more closely they are associated with rocky habitats the more discontinuous is their distribution. This is best shown by the most common species, *Sceloporus biseriatus*, which occurs wherever there is an outcrop, from the valley of the Humboldt to the summits of the Carlin Peaks, and nowhere else. The discontinuous and chiefly montane distribution of the forms of this group may then be attributed to their association with rocky habitats, and by assuming that the present outcrops are remnants of much larger exposures which at an earlier time in the cycle were connected.

It should be noted that this conclusion does not require the further assumption that the saxicolous forms cannot cross the soil areas between outcrops, although such migrations must be very rare, for not a single specimen of any of these species was found except on or near rocks. The general absence of the species from the areas covered with soil would seem to show that they cannot thrive under such conditions, so that one may grant occasional migrations between outcrops and still be led to the conclusion that the fate of the species will be that of the exposed rock areas.

The species confined to the basin floor are not scansorial in habit. *Phrynosoma hernandesi*, *Crotaphytus wislizenii*, and *Cnemidophorus tigris* are all ground forms which do not even climb about in the sage bushes and are confined to areas of fine soil on the floor of the basin; and *Thamnophis ordinoides elegans* is a ground and semi-aquatic species confined to the vicinity of permanent streams. For some undetermined reason, however, the first three species are very local in distribution, so that the association with habitats characterized by a fine soil may not be the determining factor in the distribution. On the other hand, *Sceloporus graciosus* is a common form and, while not strictly confined to the basin floor, is rare in the mountains and also on the basin floor except on the finest soil on the sides of the valleys of Maggie Creek and the Humboldt River, where it occurs in great abundance. This species climbs about in the sage bushes, but is principally a ground form and is not found in rocky habitats in the region studied.

The distribution of the basin floor forms is apparently continuous, and the common species, *Sceloporus graciosus*, occurs at all altitudes. The distribution of *S. graciosus* at least may then be explained by its association with fine soil and the fact that such soil is to be found principally along the valleys of the largest streams at this stage of the cycle.

The three species which are found in apparently equal abundance in the mountains and on the basin floor, *Bascanion constrictor vetustum*, *B. taeniatum*, and *Pityophis catenifer sayi*, are apparently equally at home in all habitats, regardless of the nature of the soil or the presence of rocks.

*The Succession of Habitats.* If the topography and distribution have been correctly interpreted, one must conclude that in this region the habitats of the terricolous forms are being extended at the expense of those of the rock dwellers as the land is being reduced to a base level; and that if the rate of dissection is not increased the latter will become extinct, while the terricolous species are destined to become the dominant elements in the fauna. The distribution of the reptiles in Maggie Basin thus in large part admits of a physiographic interpretation and provides an example of the influence of base-leveling upon the distribution of animals.<sup>2</sup>

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<sup>2</sup> Compare J. B. Woodworth: The Relation between Baseleveling and Organic Evolution, *Amer. Geol.*, Vol. 14, 1894, pp. 209-235; and Charles C. Adams: Baseleveling and Its Faunal Significance, with Illustrations from the Southeastern United States, *Amer. Nat.*, Vol. 35, 1901, pp. 839-851.

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## PHOTOGRAPHS OF GEOGRAPHICAL INTEREST IN WASHINGTON

The Forest Service has a collection of 30,000 photographs mounted, labeled, and classified. In addition, there are 70,000 other negatives. The photographic collection is in charge of an attendant who gives her whole time to the work and who assists inquirers. The photographs are sold at 10 per cent. advance on the cost of printing, and average from 6 to 15 cents each. Lantern slides are made of any photograph and sold at 40 cents each. The Service has also a large collection of lantern slides illustrating various phases of forestry and related subjects, from which sets are loaned to reliable persons or institutions for short periods, the borrowers paying transportation charges and assuming responsibility for loss or breakage. An outline of the subjects of these slides is furnished on request.

The Forest Service also has a set of 44 large, mounted photographs, arranged in 11 series, 4 in each series, illustrating some special feature of forest work or forest conditions in the United States. Each series of 4 photographs is mounted on a strip of green denim cloth, with eyelets at the upper end for hanging on the wall. The exhibit may be engaged for a short loan by any school, library or educational institution willing to pay the transportation charges.

The Forest Service has prepared 64 samples of commercially important woods of the United States, with short statements of their principal uses and physical characteristics, maps showing the regions in which they grow, and maps and charts of wood production. The material is arranged on photographic mounts measuring 16½ by 10 inches each, and these mounts are affixed to strips of green denim, four on each strip, with eyelets in the upper corners for hanging. The exhibit is loaned to any institution paying the transportation charges.